Claims 1-18 (cancelled herewith)

19. (new) A method for controlling a paper machine, comprising the steps of:

solving difference equations obtained by differentiating heat transfer equations that hold true among a steam drum, web and canvas;

predicting a dryer steam pressure after grade change; and

using said predicted dryer steam pressure as a dryer steam pressure setpoint after grade change; wherein

the initial value of a web's moisture percentage at a dryer part inlet is calculated according to changes in a bone dry coated weight and machine speed when solving said difference equations; and wherein

the initial value of said web's dryer part inlet moisture percentage after grade change is evaluated according to the following equation;

initial value of web's moisture percentage =

$$MPNowInit + A_1 \cdot \frac{BD_2 - BD_1}{BD_1} + A_2 \cdot \frac{V_2 - V_1}{V_1}$$

where

BD_1 = bone dry weight before grade change

BD_2 = bone dry weight setpoint after grade change

V_1 = machine speed before grade change

V_2 = machine speed setpoint after grade change; and

A_1, A_2, and MPNowInit = parameters.

20(new) The method of claim 19, wherein said parameters A_1, A_2 and MPNowInit are tuned according to the status of operation.

21.(new) A system for controlling a paper machine, comprising:

an initial settings block for acquiring current operation status data and determining an incremental time interval for differential calculations from such data items as machine speed and the circumference of a steam drum;

a moisture percentage calculation block;

a drying rate coefficient calculation block for evaluating a drying rate coefficient by simulation;

a steam pressure prediction block, to which the outputs of said initial settings block, said moisture percentage calculation block and said drying rate coefficient calculation block are applied in order to solve difference equations obtained by differentiating heat transfer equations that hold true among a steam drum, web and canvas, and thereby predict a dryer steam pressure after grade change; and

a controller to which the output of said steam pressure prediction block is applied; wherein

said moisture percentage calculation block calculates the initial value of a dryer part inlet moisture percentage used when said steam pressure prediction block solves said difference equations according to changes in one dry coated weight and machine speed, and said controller controls a paper machine using said

predicted steam pressure output by said steam pressure prediction block as a steam pressure setpoint after grade change; and wherein

the initial value of said web's dryer part inlet moisture percentage after grade change is evaluated according to the following equation:

initial value of web's moisture percentage =

$$MPNowInit + A_1 \cdot \frac{BD_2 - BD_1}{BD_1} + A_2 \cdot \frac{V_2 - V_1}{V_1}$$

where

BD_1 = bone dry weight before grade change

BD_2 = bone dry weight setpoint after grade change

V_1 = machine speed before grade change

V_2 = machine speed setpoint after grade change; and

A_1 , A_2 and MPNowInit = parameters.

22. (new) The system of claim 21, wherein said parameters A_1, A_2 and MPNowInit are tuned according to the status of operation.

23(new) A method for controlling a paper machine wherein raw pulp is discharged onto a wire part, moisture contained in said raw pulp is removed by said wire part and by other means to form a web, said web is dried by a pre-dryer part and a size is applied to said web, and then said web is further dried by an after dryer part so that a product is produced, comprising the steps of:

calculating the bone dry coated weight of a size from the size's flow rate, size's concentration, size's specific gravity, machine speed, and web width;

evaluating said web's moisture percentage at an after dryer part inlet after a size press from said bone dry coated weight; and

controlling said pre-dryer and after dryer parts using said evaluated moisture percentage; and wherein

said bone dry coated weight of a size is calculated according to the following equation:

size's coated weight = $CW = A(F \times S \times W)/(V \times d)$

where

F = size's flow rate

S = size's concentration;

W = size's specific gravity

V = machine speed

d = web width; and

A = constant;

said web's moisture percentage at an after dryer part inlet after a size's press is evaluated from said bone dry coated weight; and

said after dryer is controlled using said evaluated moisture percentage.

24(new). The method of claim 23, wherein an absolute moisture percentage at said after dryer part inlet after said size press is evaluated according to the following equation:

web's absolute moisture percentage at after dryer part inlet =

$$[absM_0 + CW(100 - S)/S]/BD_{AFT}$$

$absM_0$ = amount of moisture per unit area of web before size coating (calculation by simulation)

BD_{AFT} = bone dry weight at pre-dryer part outlet

CW = size's bone dry coated weight; and

S = size's concentration (%).

25.(new) A system for controlling a paper machine, comprising:

a web production block for producing a web not yet subjected to size coating;

a pre-dryer part for drying said web produced by said web production block;

a size coating block for coating a size onto said web;

an after dryer part for drying said size coated web;

a moisture percentage of said size coated web; and

a controller, to which the output of said moisture percentage calculation block is applied in order to control said pre-dryer and after dryer parts; wherein

said moisture percentage calculation block calculates the bone dry coated weight of said size according to equation 1 below, as well as the absolute after dryer part inlet moisture percentage of said size coated web according to equation 2 below:

$$\text{size's bone dry coated weight} = CW = A \cdot \frac{FxSxW}{Vxd} \quad ..(1)$$

web's absolute moisture percentage at after dryer part inlet=

$$\frac{absM_0 + CW \cdot \frac{100-S}{S}}{BD_{AFT}} \quad ...(2)$$

where

CW = size's bone dry coated weight

F = size's flow rate

S = size's concentration (%)

W = size's specific gravity

V = machine speed

d = web width

A = constant

$AbsM_0$ = amount of moisture per unit of area of web before size coating (calculation by similation); and

BD_{AFT} = bone dry weight at pre-dryer part outlet

26.(new) A method for controlling a paper machine wherein raw pulp is discharged onto a wire part, moisture contained in said raw pulp is removed by said wire part and by other means to form a web, said web is dried by a pre-dryer and a size is applied to said web, and then said web is further dried by an after dryer so that a product is produced, comprising the steps of:

calculating the predicted bone dry coated weight of a size after grade change according to said size's bone dry coated weight before grade change, said size's concentration before grade change, and said size's concentration setpoint after grade change; and

determining said web's moisture percentage after grade change at an after dryer part inlet from said predicted bone dry coated weight; wherein

said predicted bone dry coated weight of a size after grade change is evaluated according to the following equation;

predicted bone dry coated weight of a size after grade change =

$$CW^* = CW \cdot \frac{S_t^*}{S_t}$$

where

CW^* = predicted bone dry coated weight of size before grade change

CW = bone dry coated weight after grade change of size

S_t = size's concentration before grade change; and

S_t^* = size's concentration setpoint after grade change.

27(new) The method of claim 26, wherein a dryer inlet moisture percentage after grade change is evaluated according to the following equation:

absolute dryer inlet moisture percentage =

$$[absM_0 + CW^*(100 - S_t^*)/ S_t^*]/BD_{AFT}$$

where

$absM_0$ = amount of moisture per unit area of web before size coating (calculation by simulation)

CW^* = size's predicted bone dry coated weight after grade change

BD_{AFT} = bone dry basis weight set point at dryer outlet; and

S_t^* = size's concentration setpoint after grade change.

28.(new) The system of claim 25, wherein said moisture percentage prediction block calculates the bone dry coated weight of said size after grade change according to equation 1 below, as well as the after dryer part inlet moisture percentage of said size coated web after grade change according to equation 2 below:

$$CW^* = CW \cdot \frac{S_t^*}{S_t} \qquad \ldots(1)$$

absolute after dryer part inlet moisture percentage =

$$\frac{absM_0 + CW^* \cdot \frac{100 - S_t^*}{S_t^*}}{BD_{AFT}} \qquad ..(2)$$

where

CW = bone dry coated weight of size before grade change

CW^* = predicted bone dry coated weight of size after grade change

S_t = size's concentration before grade change

S_t^* = size's concentration setpoint after grade change

$absM_0$ = amount of moisture per unit area of web before size coating (calculation by simulation); and

BD_{AFT} = bone dry weight at pre-dryer part outlet

29.(new) The system of claim 25, wherein the moving average of measured values are used as the flow rate and concentration of said size.

30.(new) The system of claim 23, wherein the moving averages of measured values are used as the flow rate and concentration of said size.

31.(new) A method of controlling a paper machine, comprising the steps of:

solving difference equations obtained by differentiating heat transfer equations that hold true among a steam drum, web and canvas;

predicting a dryer steam pressure after grade change; and

using said predicted dryer steam pressure as a dryer steam pressure setpoint after grade change; wherein

the initial value of a web's moisture percentage at a dryer part inlet is calculated according to changes in a bone dry coated weight before grade change and setpoint after grade change, and changes in machine speed before grade change and setpoint after grade change when solving said difference equations.

32.(new) A system for controlling a paper machine, comprising:

an initial settings block for acquiring current operation status data and determining an incremental time interval for differential calculations from such data items as machine speed and the circumference of a steam drum;

a moisture percentage calculation block;

a drying rate coefficient calculation block for evaluating a drying rate coefficient by simulation;

a steam pressure predicting block, to which the outputs of said initial settings block, said moisture percentage calculation block and said drying rate coefficient calculation block are applied in order to solve difference equations obtained by differentiating heat transfer equations that hold true among a steam drum,

web and canvas, and thereby predict a dryer steam pressure after grade change; and

a controller to which the output of said steam pressure prediction block is applied; wherein

said moisture percentage calculation block calculates the initial value of a dryer part inlet moisture percentage used when said steam pressure prediction block solves said difference equations according to changes in a bone dry coated weight before grade change and setpoint after grade change and changes in machine speed before grade change and set point after grade change, and said controller controls a paper machine using said predicted steam pressure output by said steam pressure prediction block as a steam pressure set point after grade change.

33.(new) A method for controlling a paper machine wherein raw pulp is discharged onto a wire part, moisture contained in said raw pulp is removed by said wire part and by other means to form a web, said web is dried by a pre-dryer part and a size is applied to said web, and then said web is further dried by an after dryer part so that a product is produced, comprising the steps of:

calculating the bone dry coated weight of a size before and after change of grade from the size's flow rate, size's concentration, size's specific gravity, machine speed before and after grade change, and web width;

evaluating said web's moisture percentage at an after dryer part inlet after a size press from said bone dry coated weight; and

controlling said pre-dryer and after dryer parts using said evaluated moisture percentage.

34.(new) The method of claim 33, wherein said calculating step comprises calculating the predicted bone dry coated weight of a size after grade change according to said size's bone dry coated weight before grade change, said size's concentration before grade change, and said size's concentration setpoint after grade change; and wherein said evaluating step comprises determining said web's moisture percentage after grade change at an after dryer part inlet from said predicted bone dry coated weight.

35.(new) A method of controlling a paper machine wherein a web is wound around steam drums of a steam dryer along with canvas so that said web is dried, and the steam pressure after grade change applied to each steam drum is predicted and controlled in order to change the moisture percentage of said web toward a given setpoint during grade change, comprising the steps of:

adapting thermal equilibrium equations between said steam drum and said canvas, between said steam drum and said web, and between said canvas and said web, and rewriting said thermal equilibrium equations into difference equations;

acquiring before grade change at least the steam pressure of said steam dryer, basis weight of said web, machine speed, and dryer part outlet moisture percentage of said web, by using sensors;

applying an initial after dryer part inlet moisture percentage of said web, as well as other initial values, to said dif-

ference equations;

solving said difference equations repeatedly at a given time interval corresponding to a difference travelled by said web;

determining the drying rate coefficient of said web and a pattern of said web's steady state moisture percentage transition along the direction in which said web moves within said dryer part, by repeating said solution step until a calculated final moisture percentage agrees with an actual measured value acquired with a sensor to within a given tolerance range;

acquiring at least the preset basis weight of said web, present machine speed, and preset dryer part outlet moisture percentage of said web as operating process variable after grade change when making a grade change;

applying a value to said difference equation as the initial dryer part inlet moisture percentage of said web;

varying said steam pressure applied to each of said steam drums, in order to make said calculated final moisture percentage agree with said initial dryer part outlet moisture percentage to within a given tolerance range;

solving said difference equations repeatedly at a given time interval corresponding to a distance traveled by said web;

determining a pattern of said steam pressure applied to each of said steam drums along the direction in which said web moves; and

varying said steam pressure applied to each of said steam drums, so that the variation of said steam pressure agrees with

said steam pressure pattern when an actual grade change is made.

36.(new) A system of controlling a paper machine wherein a web is wound around steam drums of a steam dryer along with canvas so that said web is dried, and a steam pressure after grade change is applied to each steam drum is predicted and controlled in order to change the moisture percentage of said web toward a given setpoint during grade change, comprising:

storage means for adopting thermal equilibrium equations between said steam drum and said canvas, between said stream drum and said web, and between said canvas and said web, and storing said thermal equilibrium as different equations;

detection means for acquiring before grade change at least the steam pressure of said steam dryer, basis weight of said web, machine speed, and dryer part outlet moisture percentage of said web;

calculating means for applying an initial after dryer part moisture percentage of said web, as well as other initial values, to said difference equations, solving said difference equations repeatedly at a given time interval corresponding to a distance traveled by said web, and determining the drying rate coefficient of said web and a pattern of said web's steady state moisture percentrage transition along the direction in which said web moves within said dryer part, by repeating said solution step until a calculated final moisture percentage agrees with an actual meas-

ured value acquired with a sensor to within a given tolerance range;

setting means for acquiring after grade change and setting at least the preset basis weight of said web, present machine speed, and preset dryer part inlet moisture percentage of said web as operating process variables after grade change when makin a grade change;

input means for applying a value to said difference equations as the initial dryer part inlet moisture percentage of said web;

another calculation means for varying said steam pressure applied to each of said steam drums, in order to make said calculated final moisture percentage agree with said initial dryer part outlet moisture percentage to within a given tolerance range, solving said difference equations repeatedly at a given time interval corresponding to a distance traveled by said web, and determining a pattern of said steam pressure applied to each of said steam drums along the direction which said web moves; and

variation means for varying said steam pressure applied to each of said steam drums, so that the variation of said steam pressure agrees with said steam pressure pattern when an actual grade change is made.